

ENGINEERING HERITAGE AUSTRALIA

NATIONAL ENGINEERING ORAL HISTORY PROGRAM

Transcript of Interview with

JOHN GORDON LEWIS

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Transcriber	Mary Macfarlan
Date of Interview	6 January 2009
Venue	Quinns Rocks, Perth, Western Australia
Duration	2 hours

NOTES TO THE READER ON INTERPRETATION OF THIS TRANSCRIPT

Readers of this oral history transcript need to be aware that it is a verbatim transcript of the words as spoken during the interview that was conducted in the form of a natural conversation between the interviewer and the person being interviewed. Some minor changes have been made to facilitate the flow of the document.

Much of what is said in such interviews relies upon the accuracy of the memory of the person being interviewed and readers should bear this in mind and judge for themselves how factually accurate the material is. The interviewer has sought to clarify or verify facts and statements made during the interview where this seemed appropriate.

The views and opinions expressed within the transcript are those of the person expressing them in the interview.

Please refer to the notes on the following page to aid interpretation of the transcript.

Note 1

The recording comprises five parts and is on two compact discs (CDs) in 'wav.' format. It runs for a total of 2 hours.

Note 2

Where the interviewer has used words such as 'Yes', 'Right' or 'OK' as an encouragement, but not as anything else then these words have not been transcribed unless they are relevant for the context.

Note 3

The interviewer has inserted occasional words (which are not in the original recording) into the transcript in order to clarify the context of what was being said. These words are shown in the form [*they would say*].

Note 4

Where a sentence has a series of dots in the text such as this indicates that the speaker paused, the recording was not clear enough to transcribe accurately what was said, there was pause, or the following speaker interrupted what was being said.

Note 5

Numbered footnotes have been provided in the text in order to assist the reader.

Note 6

The interviewer is referred to as 'Ayre' in the transcript and to the subject speaker is referred to as 'Lewis'.

Track/
Time

1/00 Ayre This is an interview with Mr John [Gordon] Lewis who is speaking with Doug Ayre as part of the Engineering Heritage Australia Historical Research Project. The interview will form part of an oral history archive.

Now John before we begin I need to make sure you understand your rights in relation to this interview.

Firstly that you may terminate this interview at any stage.

Lewis Understood.

Ayre Secondly do you understand that you will control access to the information given during this interview by filling in the consent form?

Lewis Yes. I understand that.

Ayre Thirdly do we have your permission to make a transcript of this recording?

Lewis Yes, that's fine.

Ayre Thank you.

This interview is taking place on the sixth of January two thousand and nine at Mr Lewis's home in Perth, Western Australia.

Mr Lewis can we start by asking you if you're happy for me to refer to you as John?

1/01 Lewis Surely, yes.

Ayre Thank you.

Well, can we begin then by talking about your schooling; primary and secondary schooling? Could you tell me about that please?¹

Lewis Right. Primary school was a bit of a mix up because my family lived on group settlement in a country town near Margaret River called Cowaramup. The upshot was I never went to school until I was ten and I was on what was called 'correspondence' then. It's now 'distance education'. So my mother taught me really.

1/02 Lewis Then we moved to Quairading. I had two years in Quairading which

¹ Mr Lewis later advised that he was born in London on 23 February 1925.

would have been nineteen thirty six - thirty five and thirty six. That was a good experience I enjoyed the schooling at Quairading. Two classrooms; a good teacher.

Then moved to North Perth where we had a corner store and I went to North Perth School which was very good at getting scholarships at the [Perth] Modern School. And then I succeeded in doing that. So I began at Modern School in thirty eight, thirty nine, forty. Left in forty one before the Leaving because it was war time obviously. And I went out working for the Public Works Department at that time.

So that was my secondary schooling. I was never an apprentice. I did become a cadet draftsman with the Public Works and a cadet engineer. A cadet engineer in nineteen forty five I believe it was. During the war years I'd gone to technical college at Perth doing structural engineering but then I began at university in forty five - just as the war guys were coming back - and I completed my degree at UWA.

Do you want me to go on with the post graduate too at that point?

Ayre Just pause at that at the moment.

I'll just go back to your childhood. You mentioned your parents had a corner shop?

Lewis In North Perth.

Ayre What sort of shop was that?

Lewis In the years - the thirties until the war - corner shops in Perth and around Australia, I suppose, were pretty standard things. They used to sell everything – newspapers, vegetables, cheese - the lot. Long hours but yes they were quite a good business and interesting for kids. My father - he quite enjoyed that sort of business.

1/04 Lewis Vegetables for instance were provided by a cart run by Chinese chaps in local gardens at that time. The horse used to know his way round the streets so he used to stop at our place.

Yes it was good experience being in a corner shop.

Ayre So did you work in it as a child?

Lewis Oh yes, yes, and my sister too, who was a couple of years younger. So we used to deliver grocery orders to various good customers round the place with a push bike and a basket in the front. And we used to serve on the counter. We used to cut cheese and salami and things like that. Yes, so for an eleven, twelve, year old kid that was pretty good experience.

Ayre Indeed.

Lewis And of course a lot of people couldn't pay their bills in those days. You'd be very carefully what you were ticking up.

Ayre You had to know your customers I presume?

Lewis Oh, yes.

1/05 Ayre Yes. Alright, perhaps we can then go on now to talk about post graduate studies. You studied as an under-graduate student at UWA?

Lewis Yes.

Ayre And you got a degree there. What degree did you get?

Lewis The degrees were all one type; there was just a Bachelor of Engineering in those days. There was mechanical and electrical [which] were not differentiated in any way that I can remember. So I got that [degree] and it was issued in forty eight because I was given one year in for the work I'd been doing at night school at the Technical College.

So then I worked as an engineer for the Public Works for several years and I applied for and got a Gledden Fellowship which was a valuable thing to get in those days in nineteen fifty one. And then I went with that to Imperial College in London and I did soil mechanics and hydraulics. Things like that and got a Masters Degree there after a couple of years.

That was a good experience - mainly in nineteen fifty two and fifty three in London - and the chap in charge of Public Works at that time was Russell Dumas and he was good enough firstly to help me get the thing but secondly to give me half pay while I was away. So I was really quite well off by student standards and I enjoyed that time. And Russell said to me 'John I'm not going to get you to sign anything I just want to shake your hand and you tell me you're coming back.' And that's what happened.

Ayre Well I think reading between the lines there you clearly had a very good academic record?

Lewis I did yes.

Ayre You did?

Lewis Yes.

Ayre And I suspect that you were seen as a person with considerable promise?

Lewis Mmm. Yes, that'd be right. Yes.

Ayre I bring that point out because you may be reluctant to admit it.

1/07 Lewis Ah well to win a Gledden Fellowship was a hard thing to do.

Ayre Was it?

Lewis Oh yes.

Ayre Why was that?

Lewis Ooh, some years none were given at all. It was open to science as well as engineering and medicine and as a rule there was only one a year or two a year for the whole of the State.

Gledden, of course endowed money to the university and there's still a Gledden Building in Hay Street in Perth. There was Robert and Maude Gleddon - brother and sister. Yes I was pretty lucky to get it at that time.

Ayre Now, you were working then for the Public Works Department as it was then called. On your return what were the positions that you held?

1/08 Lewis I was always quite keen on design and investigation and really a department was created - Planning Design Investigation - called PDI so I was the engineer in charge of that for the whole of the Public Works.

I finally left the Public Works in about nineteen sixty four and went out into private practice because things like the iron ore projects were coming on. Previous to that if you went into private practice, as a couple of guys did, you more or less starved because you couldn't get any work.

Anyway, I enjoyed my time with Public Works. I was given a very good innings I travelled around the world to conferences and things like that a great deal. Never really restricted but I believe I did give a lot back, you know, when it came to designing dams and things like that because that was my strong thing - the design of dams - of which I did about eight around the south west and the Kimberley.

Ayre Eight dams around the south west and the Kimberley?

Lewis Mmm.

1/09 Ayre Okay, well perhaps we can come back to those in a moment.

So can we just recap on the positions that you held with the Public Works Department then, starting from cadet engineering days?

Lewis Yes.

Ayre What were the positions that you held?

Lewis First one was a cadet draftsman in the drawing office. That was from forty three to forty four. And at night school - in order to get into the university at all; you had to get a Leaving Certificate - which I did at night school and got a pass sufficient to get me in. So they converted me in forty five from a cadet draftsman to a cadet engineer. It meant all of the holidays I worked for the Public Works on the sites here, there, any everywhere, mostly driving a motor bike in those days.

And on graduation I automatically became a fully qualified engineer. My cadetship was finished and discharged. I had had a modest amount of pay during all of my cadetship - plus I think from the Commonwealth Government I had two pounds a week. Or something like that because we didn't have a lot of money for me to be going through university, but it just made all the difference. The fees were very small in those days.

Ayre Okay. So you went from a cadet engineer to what position?

Lewis I guess a design engineer. I think the Planning Design Investigation started about nineteen fifty seven.²

Ayre I paused there for the bird.

Right you were saying - you were talking about the positions you held.

1/11 Lewis Yes. About nineteen fifty seven I became an engineer for Planning Design Investigation. I think there were seven groups. There was Harbours and Rivers as it used to be. There was North West and half a dozen others. Irrigation and Drainage, Water Supply 'cos there were a lot of country towns under Public Works.³

Yes, so I was a branch head at a fairly young age but I could see ultimately that, you know, people would wait for the guy in front of them to die off and make a position 'cos people didn't jump from one department to another in those days. And I thought oh I'm still young enough I'm not going spend the next twenty or thirty years waiting for a position to become vacant.

² Interruption at this point.

³Plus Construction, Sewerage, Goldfields Water Supply, Country Towns Water Supply.

The other thing was I suppose that I finished up in charge of that department but there was a lot of administration - a lot of files, parliamentary questions, setting people on their salary applications year by year, and I remember I was one of the better ones at that. I used to use tape recorders like this. I used to have three secretaries. I used to keep them going and they, of course, were good at shorthand in those days and they'd get the letters done that afternoon.

But, yes, by eleven o'clock I'd worked really hard I'd get rid of a heap of files about that deep.⁴ About morning tea time you think 'Well, I can now get and do some real engineering' and an office boy would come in with another heap of files just as high as that. And when you saw the yellow - sorry the pink stickers - on them you had to deal with those [as a priority] because they were Parliamentary Questions and you had to be sure that the answer you gave was the same as you gave last time. And that meant there was no time to go down to the Under Secretary or the Director of Engineering. You gave them a copy of what you'd done but you had your own filing system and they wanted a reply that day.

But I reckoned that wasn't for me for ever.

- 1/13 Ayre So you were a Branch Head at a fairly young age? And where did you go from there?
- Lewis I went out consulting to a firm that ultimately became Halpern, Glick and Lewis.
- Ayre So you left the Public Works Department?
- Lewis Left the Public Works in nineteen sixty four.
- Ayre And the Lewis in Halpern, Glick and Lewis was that yourself?
- Lewis That was me. Yes.

You've got a little note here about lessons learnt from mistakes and failures by myself and other people. I've got a question mark there. I can think of a myriad of things you perhaps shouldn't have done, or should have done, about what other people did wrong in those days or did right. You could write a book on that.

- 1/14 Ayre Indeed you could, yes. I just - I would - ask that question because I feel that much of engineering, and engineers generally, have learnt from their mistakes and the mistakes of others.
- Lewis Mmmm.

⁴ Indicated a dimension of about 300 mm with his hands.

Ayre You know?

Lewis Yes.

Ayre Anyway we can probably come back to that.

Lewis Right.

Ayre Now you worked with Halpern, Glick and Lewis for quite a few years I presume?

Lewis Probably about eight. I think about nineteen seventy two I left them. I had some private interests in, well, investments, shopping centres and cutting up bits of land and things like that. They said 'Well, you know, we're quite happy. We don't care' and I said 'Well, it's eating in to my time in the practice'. And I continued as a consultant on some things but, really, most of my big work in civil engineering was done by that time.

But later on - I'll come to the things I did as a consultant later - and a lot of them were since nineteen ninety - the last eighteen years - when I've been pretty much half retired anyway. Some quite big things I've been consultant on.

Ayre Now, membership of professional and industry bodies. Can you tell me what you've been involved in?

Lewis There's only the one. That's the Institution of Engineers and I was on their State Committee for some years.

Ayre And did you hold any senior positions in the Institution?

Lewis No. No.

Ayre Public honours?

1/16 Lewis No. No public honours. No. Industrial experience and training not much. There wasn't a lot of training in those days. You really learnt and taught yourself - but you were out there on your own - you didn't have too many people to help you.

Ayre We talked a few moments ago about lessons learned from mistakes and failures. Are there any lessons that come readily to mind that you perceived of as learning or you learnt yourself?

1/17 Lewis Oh, I don't know about lessons but, you know, I served under a number of extremely diligent and good chaps like Dumas I've mentioned. Dumas was a special guy who became a Knight. He was particularly good at dams but he was a good administrator as well.

But he worked his own way. He didn't have a lot of staff around him. He was the, sort of, king and that was it. And you didn't argue with Russell, you know. If you didn't agree with something you told him once and that was it and he'd say yes or no. I liked him. I found him good to work with 'cos I knew where I stood.

Victor Munt was another chap I worked under. Victor Munt was the son of a previous Under Secretary for Works. Victor Munt died at the age of forty seven. Very young. Heart problem I'm sure. He was a Bachelor of Arts as well of Engineering. He was no way cut out to be a civil servant - he was a dreamer - he had lots of ideas. He never knew which were the good ones but there often were good ones among them. A chap who knew him well was Ken Kelsall who's still about and you may know Ken. Ken didn't like him very much but I did like Victor and he was certainly good to me. But, you know, as an administrator - a terror - hopeless.

Then we had a number of chaps who'd come out from England a chap called Santo Crimp - he became Hydraulic Engineer as they called it. There was a chap called Edwards - he was on drainage. A chap called Hutchison on water supply. The three of them apparently came out in about nineteen twenty six in the heart of the Depression in Europe and the three of them were just hopeless. They were not properly trained - poor administrators - you couldn't get through to them. They were defending their lack of training.⁵

Still, lots of good experiences [and] lots of bad experiences.

1/19 Lewis In those days too I used to do a fair bit of work round the harbours for submarine nets to keep the [enemy] subs out and what not. A chap called Stephenson Young was the engineer for Harbours and Rivers. People found him difficult but I found him okay because I always used to finish what he told me to do. Yes, I found Stephenson Young okay to work with.

Ayre Alright. Let's move on to workplace safety. Going back to your beginnings what were the standards of workplace safety like particularly out on sites?

1/20 Lewis Compared to the present practices absolutely dreadful. Absolutely dreadful. And I was one of them you know. Our business was to get things done. A typical job I'd be on - particularly in the holidays from university - you'd have say twenty eight people with you and you'd have a foreman and three gangers. A gang was generally eight people and some of those guys became gangers because they were the best fighter in the bunch.

⁵ Mr Lewis later mentioned that you never used first names with these people.

They were quite loyal. They'd do what you instruct them, you know.

But it was always dangerous particularly lifting with limited gear, you know. We didn't have much in the way of cranes - a lot was done with guy ropes and gin poles and rigging.

Some dreadful risks we used to take. I never had anyone killed but I was party to it as well but, oh, these guys, these days they'd have a heart attack on the spot.

Ayre Well, I mean, we're all men of our times aren't we?

Lewis Mmm.

Ayre Did you perceive it as dangerous in those days though; probably not?

1/21 Lewis No. My father cleared a farm down at Cowaramup - a hundred and sixty acres - most of it. He'd been a rigger on a wind jammer at one time as a young fellow.

We had two draft horses and chains and hooks and a tree puller and we cleared forest up to four foot six [inches] in diameter with that equipment. You'd pick a big tree and pull the other trees in towards it and burn them. So I was pretty used to that sort of risky business. When the tree was coming down you just got out from under.

Ayre So do you see significant changes that have taken place today then?

Lewis In workplace safety?

Ayre Yes.

1/22 Lewis Oh yes. Enormous. Yes. I suppose generally for the good but it was world wide. You've see on some of these pictures of the sky scrapers in New York [with] guys on about the eightieth floor walking along a beam with no belt, no nothing. Windy. Oh yes. So it was world wide.

Sydney bridge, you know, there were a lot of things there. If you asked whoever was on that - if there's any of them still around - that was a pretty dangerous job.

Ayre Well, moving then from safety to technology have you seen any changes in technology impacting on working life and society?

Lewis Ah well, enormous changes to technology. To society yes. To working conditions, well, to education that's probably the biggest thing.

Education, because in those early years, say nineteen forties and

fifties - even a place like the Water Supply Department which was separate - the engineers were really on easy street 'cos it was run by foremen. The whole of the Metropolitan Water Supply Sewerage and Drainage Department was run by foremen and they were good and they did not appreciate young engineers coming in to tell them what to do. It was very hard to break in to there.

Public Works was a little bit like that. Harold Hunt, for instance, who you know very well. Harold went through that transition with the Public Works of improving safety, of using contractors rather than direct labour. Now I think when that switch-over came to using contractors in about nineteen sixty for hospitals, dams, all the rest of it, that was a turning point in the equipment that was used, the type of administration that was used and when people had to account for their expenditure of money. Previously they didn't. It just cost what it cost.

Lots of things I could talk to about that - but I suppose [with] me coming back in fifty seven in charge of Planning Design Investigation some people would have wondered, 'well, what on earth does that mean?', 'cos things didn't get investigated prior to that. They just did them when they thought it was politically a good thing to do.

Planning, yes, planning wasn't a big thing with government departments up to that time and feasibility [studies] - never heard of them. Economics no. There was no economic study done for the Ord Dam, not really, or any of those dams in the south west. Even the raising of Mundaring Weir - the raising of Wellington Dam - they were political things, you know. For the good of the State for sure but we never did a study to see whether it was worthwhile or not.

1/25 Ayre So can I say in summarising that, then, it would seem that the decisions were made on the assumption that the benefits were self evident?

Lewis Yes. Yes. Yes. But it also depends a bit on the politician - which area. - if he was a strong politician he would win over other areas.

Yes. Another thing, of course, the major thing - a bit later is - in those days there was no such thing as environmental review. None of the projects I was on, early on, whether it be water supply for towns - not one of them had any sort of environmental review. We didn't have the staff for it. The requirement was not there. There was no Department of the Environment. So that really became strong in about the eighties.

1/26 Ayre So all of these changes, economic studies, and feasibility studies, and environmental studies, do you see that as an improvement?

Lewis I've got mixed feelings about some of this environmental stuff as far as Western Australia's concerned. But I thoroughly agree with a financial and engineering feasibility study because, really, if the project's that good you should have no problems with that. It also enables you to make comparisons to see if you can improve it or if some other variation is a better deal altogether.

Yes, that's been an improvement and it's meant that areas like the PDI that I was in gained strength over the years and were better staffed.

Ayre What about changes in technology in the office? Have you seen changes and benefits there?

1/27 Lewis Yes. They were vast in fact. I've got a bit of a hobby horse on this one.

Compared to say in the nineteen fifties and the sixties the productivity per qualified engineer say in the Public Works Department- and I think you could safely say the Water Supply Department and Main Roads - the productivity per engineer was enormous. And each guy was allowed a very wide scope. It was his job to do this and to do that, and you know, they'd kick his arse if he made a mess of it but you always got a second go.

These days it takes roughly twenty guys to do the same amount of work as one did in those days and we see it for instance dealing with - to this day - Chevron, Woodside any of those oil companies. Chevron for instance on their job at the Gorgon which I'm well and truly in touch with. Something like four hundred engineers have worked for a number of years on Gorgon still without a result - and the expenditure is of the order of two hundred million dollars a year - and all you see is a great big stack of books at the end of it. Nothing approved.

It's part of their process and I don't really know and I've thought about this a lot. Is it the fault of the engineers? Is it the fault of the administration? Is it indeed the fault of the changes in technology? Because now you put an email into these systems and the next thing they press a couple of buttons and that's gone to forty different guys whereas the one could have dealt with it. He feels oh, no, these fellows all have to be in the loop. But it means that in the end it's an awful long time before you get a reply and decision making. See again, in my time the decision maker was you - you knew the buck stopped right there - and I knew that Dumas would kick my arse if I made a blue - but he wouldn't want me asking what to do.

Now it's not like that. You can't get a decision out of anybody in Chevron or Woodside. Can't get a decision out of them. Takes

absolutely months. I don't know who to blame for it but I do see it

Ayre You mentioned earlier that you'd started as a cadet draftsman?

Lewis Mmm.

Ayre You would have seen a lot of changes in drafting techniques and technology wouldn't you?

Lewis Yes. Although I say it myself I was a bloody good draftsman and I've still got drawings. One of them is an 'as constructed' of a Fremantle Slipway for submarines during the war which I've got the museum working on at the moment.

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2/00 Lewis People can't use a pencil like that anymore. It was an art form. It was a bit slow but on the other hand if I had to stand beside a computer guy and, you know, there's one sheet of drawing that's wanted and you got a week to do it he'll take a week. He'll say it takes him a few hours but he'll take a week cos there's so many mistakes on the track. I could still produce a drawing in a week - a good one. It is faster I suppose. Whether it's any cheaper I don't know but the biggest advantage is that you can transmit to other people who can make an alteration and let other people know what they've done. That's a great advantage. And you know there's no ifs and buts. You know that [the] person [who] made that alteration had to sign off on it too. Which some of them don't like doing but at least you know.

2/01 Lewis So I think drafting design, word processing for specifications, and things like that yes that's been a help. I'm not real good at it myself and I'm not fast. Project planning, work scheduling, much improved but, for instance, work scheduling I think it's too bloody detailed now you've got these spread sheets and what not. It's hard to make an alteration unless you're in charge of that program. They lock you out of it. And I believe in simplifying in some things so if I can see, say a work schedule that's been got out to lay a gas pipe line or something. And I believe that should be possible on one sheet of paper but you can't get guys to do that any more. But I often go through and do that.

Mobile phones, personal computers, motor vehicles, air travel. I think air travel - since days of the Comet and what not - but you know I've travelled by air all my life.

2/02 Lewis So I've got a bit of a hobby horse in there as you can see. But it's just a sheer lack of productivity these days and that worries me.

What also worries me - is off the track a little bit - is the quality of the graduates coming through. I believe the standards are dropping and some guys at UWA are telling me 'Yes, you're right with that.' There's too much looking at that square⁶ and expecting that to give the answers. Not enough guys saying oh, you know, 'What's the problem. How do we solve that', you know, who are using brain power on it 'cos they hope this machine's going to dig them out.

And it's distressing. Some of these young fellows are just not up to it and I think that's partly why it takes so many people to do a job.

2/03 Lewis I give you one [example] if you don't mind diverting just for a moment. See, one of the most recent things I did - because my son Don and I went a joint venture with Multitplex up till say from about two thousand, two thousand and five, - and we worked over there in that nice building by the river. And John Roberts - who died a couple of years back. I knew him so well. A lovely bloke he was.

We succeeded in getting a gas pipeline project which we did with Multiplex and Saipem from Bayu Undan - which is near Timor - to Darwin. That's five hundred and seven kilometres. A pipeline; let's talk in inches - twenty six inches diameter, one inch wall thickness - and it came from Japan. It had to be weighted so it wouldn't float etc. And we had to arrange to get the pipes in the lay barge down here and set the line on the sea bed. That's five hundred and seven kilometres under water all the way. One inch wall thickness. No intermediate pumps - just the pump from the pressure where the well head was. Now that's most of the way to Kalgoorlie.

2/04 Lewis And I remember John Roberts saying - 'cos he ...we had the same problem we were just discussing - the enormous number of people involved in this and the owner in that time was Phillips Petroleum - they had too many people on as well but they're better than Woodside. John Roberts said - with all his intuition - he said 'How long is this pipeline?' 'Five hundred and seven kilometres John.' 'What's the deepest part of it?' 'A hundred and thirty metres. 'Ah, what diameter?' 'Twenty six inches.' 'What is the wall thickness?' 'One inch.' He said 'Is that the same from one end to the other?' And he drew a breath and he said 'I don't see anything very difficult about that.'

2/05 Lewis You know, this is what got John Roberts where he was. He did not see difficulties. He would not stand for fools and we laid that bloody pipeline without a great deal of difficulty and once we got motoring on it we laid it at four kilometres a day. You know that's a bloody big pipeline. Four kilometres a day under the sea and in many respects it easier to lay it under sea than it is across [to] Southern Cross or something. Anyway, I'm diverting.

⁶ Referring to the square of a computer display screen.

Ayre That's interesting. Let's have a pause there shall we?⁷

Right John. Now I'd like to move on to some of the projects that you've been involved in and I understand you've been involved in quite a few alternative energy projects.

Would you like to tell me a little about those?

2/06 Lewis On hydro. When I was doing the post graduate work in London I went on a number of trips to Europe and America looking at hydro electric plants but never really got the chance to build a big one out here. There was two megawatts put in at Wellington Dam so that was my design. And the Ord. Ultimately the main dam had thirty megawatts installed in it. But that was actually installed after I'd left the government but the design was there and the tunnels were put in on the design that I'd initiated.

Tidal power I certainly wrote a paper about tidal power but we've never been able to get it going because I guess the capital cost was fairly high.

Ayre Where would the tidal projects have been located?

2/07 Lewis Exclusively in the Kimberley. Exclusively. I think I looked at fifty sites or so up there. Sort of feasible as far as production of energy's concerned. There's a very large amount of energy but ones that were picked out early on were at Secure Bay at Walcott Inlet in west Kimberley and a smaller scale - we put several years into it about oh, around the year two thousand - Doctors Creek, just north of Derby.

Not sort of all over but it would take somebody with fairly deep pockets. Maybe Koreans or someone like that to get it going, I think.

Ayre So, the concept of tidal power, how does it work?

Lewis The simplest form is you put a dam across a fairly large inlet and have gates that let the water in. And you dam it up and let a head develop on the outgoing tide until you've got, say, five or six metres of head and then let it flow for the next eight hours through turbines.

2/08 Lewis It's not continuous by that method but you can use pumped storage or something of that sort 'cos it's so mountainous up there there's plenty of pumped storage sites. That's all well known. That's the simplest one. Simply emptying they call that one.

Yes I put a lot of time in to that but I don't know whether ... particularly with gas resources the way it is you know Kimberley has

⁷ A short break at this point.

got so much gas now fifty, sixty TCFs⁸ of gas at least.

Solar energy - I've been doing a bit on solar energy lately. I think in the long term surely to goodness Australia's got a great future in solar energy if we can get the cost of the individual units down a bit. There's lots of people working on it - especially Germans.

2/09 Ayre Just while we're on the subject of dams you talked about the Wellington Dam which I know is of interest to heritage bodies at the moment and I think it's been taken over by the National Trust. I'm not sure.

Lewis The hydroelectric plant has, I believe.

Ayre Yes. Could you tell me a bit about that dam and how it came to be, you know, utilised for electricity generation. You were responsible for the dam itself were you?

Lewis Yes.

Ayre Tell me a bit about it please.

Lewis First we - straight after the war - we raised Mundaring by thirty two feet, or ten metres, and as soon as that was finished we moved and had always intended to move over and raise Wellington Dam. So I think Wellington Dam was about nineteen fifty or thereabouts. It took a couple of years to build. We raised that by fifty feet or fifteen metres - fairly straightforward - using the same technique as for Mundaring.

2/10 Lewis Wellington Dam had been built with three outlets in it - two [of] twenty one inch which were the irrigation outlets and a thirty six inch, I think, which was a scour outlet which hadn't been used a lot. But in recent years they'd been using that scour outlet to try and get the salt water out which sits in a layer in the bottom of the dam - or fortunately does.

On the south side we thought we could do something with the actual flow to the irrigation areas so we put in, from memory, two [by] forty two inch pipes down a fairly short length maybe less than a kilometre and put a little hydro electric plant down there that was two, maybe just over, two megawatts.

Yes, we had some interest in trying to do something with that.

2/11 Lewis But I think you're right. Our latest information is that it's been given to the National Trust. And there was something in the paper not long ago saying that they were going to get it going again which seemed

⁸ TCF is Trillion Cubic Feet. A Cubic foot is a commonly used unit of volume of gas.

like a really good idea. And we were going to have a chat with them. I think my name's on the drawings as a matter of fact. We're going to have a chat with them about it [to] see if their interest in the tidal power group may be operating for them.

Ayre So why was a decision made in the first place to put a generating plant there? Do you know?

Lewis Oh it was economically alright - as an 'add on' - provided the dam paid for itself for irrigation and in part for sending water back to Narrogin and the wheat belt. Subsequently another dam was built at Harris River which is better quality water so I think most of the wheat belt water comes from the Harris dam now.

2/12 Lewis This one's entirely for irrigation. It was going a little bit brackish even in the fifties because of clearing on the Collie River catchment. I think with various controls that would appear to have stabilised from what I'm told but even so they find the need to [if they can] get rid of the salt layer in the bottom - they're pleased to do it. And I think the National Trust say, well - and we would have said too - if that saline discharge can be run through turbines well that's energy for nothing and I think that's what they were wanting to do.

2/13 Ayre You mentioned the scour pipe being used and it was used to get rid of the saline water at the bottom of the catchment⁹, What was the scour concept though? I mean, originally, what was the scour pipe used for?

Lewis Well every dam going back to CY O'Connor - and all the dams in Britain and Europe - they always had a scour pipe and the original intent, I think, was to get rid of debris and stuff that had accumulated at the bottom. But as a rule that never worked because the scouring effect just went back about a hundred metres and that was the end of it.

But when you've got a density layer of saline water it's much more effective and provided you don't do it too quickly you'll manage to get rid of a lot of the saline layer.

Ayre So am I correct in saying that saline water, with the salt in it, is more dense so it sinks to the bottom?

Lewis Yes.

Ayre And then a pipe at the bottom of the dam can take it out.

Lewis Yes.

⁹ The word should be reservoir in this context.

Ayre Now you were talking about solar energy. I think you'd finished with your comments on that?

Lewis Yes.

2/14 Ayre Now, electricity related projects then. Solar energy, of course, is often related to electricity generation - have you been involved in other electricity related projects?

Lewis Mainly gas turbines.

Ayre What involvement there?

Lewis In the - we haven't built one in our own rights - but we were very keen to build such a plant at Onslow of all places where we had a solar salt field for a number of years. We've since sold that but Onslow looked - and looks now - a great place to build a gas power station. You know, from the news you see round the place Chevron with their Wheatstone project - which is fairly clean gas - they're prepared to bring ashore and Barnett's¹⁰ agreed to old Onslow just west of the current Onslow.

2/15 Lewis BHP have got a deposit in fairly deep water at Scarborough. I think the intent is to come ashore at the same place. Our, sort of, ambition there had been to build a caustic soda plant using salt and power 'cos that's all you really need for caustic soda. What's held us up for a number of years there - and it might be nearing the end of it now - is when you make caustic soda you've got a by-product of chlorine which you can't do anything about. It's there - very hard to get rid of - very hard to ship. Its poisonous and all the rest of it.

The usual way to get rid of that is to form ethylene dichloride which is on the road to plastics and is in great demand in East Asia. Always a snag - every bright idea has a snag - and you need another bright idea to fix up the hole in the first one.

2/16 Lewis Ethylene is something that has escaped Australia generally and kept us out of major plastics.

Ethylene is usually made most economically from ethane gas [using an] ethane cracker. Australian gases generally are very low in ethane and we can't do it and that's why the idea of Shell and Dow Chemicals at the Burrup came unstuck after a couple of years - international tenders came unstuck.

So it's up to somebody really to find their way through ethylene. That links to another thing. Perhaps [this will] come up later on. but it means that salt, a gas power station, and conversion of gas to

¹⁰ Colin Barnett, Premier of Western Australia

ethylene [must be] all linked together in a chemical plant or petrochemical plant. Must be.

2/17 Lewis What we've been researching there for about five years is with an American company called Syn Fuels to convert gas to ethylene and gas to liquid fuels like diesel and gasoline. Now, there are many technologies for doing it but the most popular and best used one is called Fischer Tropsch. You may be aware of that but the Germans invented it. The South Africans perfected it but they convert either coal or gas to gasoline and that's really how South Africa survives. We're interested in doing something like that here. The one we're chasing does not use Fischer Tropsch it's a much more direct way and about half the cost to get the work going. There's a pilot plant in the very last month or two of its studies now in Houston and we've formed a joint venture with a Korean mob to try and do that at Onslow.

2/18 Lewis So yes, we are vitally interested in all those things at and around Onslow and I suppose for me that would come later in my declining years as an engineer. But that's the thing I'd like to achieve next 'cos for Australia it would be - you know - we're very gas rich but for heavy oil and what not we're getting worse and worse and worse.¹¹

Ayre So this brings us on to natural gas related projects then. Clearly you're interested in liquefaction and production of ethylene?

Lewis Liquefaction, is one, yes. Ethylene and ethylene dichloride. And once you can get on that treadmill [with] ethylene you can go to fuels. But better still, or concurrent with it, you can go to polyethylene and polypropylene.

2/19 Lewis Not that hard from that point. Many companies have got good technology for that. It would be, you know, a great deal for Western Australia if we could do that somewhere in the north whether it be Burrup, Onslow or wherever.

I think also it's worth saying that you were talking about technology for dams and things later on but the technology of harvesting deep off-shore gas by remote controls and things like without platforms that's improved out of sight. We used to talk a lot about stranded gas [but] there's hardly any of our gas that's really stranded any more. If you want to use John Robert's approach and say, you know, 'we'll go and get it', it's physically possible to do so.

Like Scarborough is nine hundred metres deep so you couldn't use a platform there but the remote gear will get it.

¹¹ The implication here is that Australia is increasingly dependent on imported fuel oil and needs to develop its own resources to reduce the level of imports.

- 2/20 Ayre When you say remote gear, the facilities are on the seabed on a pipe head, or whatever, and controlled remotely?
- Lewis Yes. Yes. And if you need to drop the carbon dioxide content a bit which we often do, you can do that on the sea bed too. 'Cos if you don't do it and the carbon dioxide content's fairly high you'll find you've got a nasty corrosion problem [in the pipe] especially for the first fifty kilometres or so where it's fairly warm as well.
- Ayre So there's an interaction with the carbon dioxide and the pipeline material is there?
- Lewis Yes.
- Ayre What interaction is that?
- Lewis It's really an acid reaction and that is the fundamental problem with Gorgon. You know, you'd wonder with Chevron why on earth they decided to bring Gorgon gas to Barrow Island which is, what, a 'C Class reserve' and got all the problems in the world.
- 2/21 Lewis It's that. They felt they couldn't go too far in a pipe line because of corrosion. They couldn't come ashore. But Wheatstone right next door - the same company Chevron - and yes, we can come ashore [to the mainland]. That's because it's better gas.
- And so you would also think well why in the hell with Gorgon why don't they treat that and I couldn't even answer that. I think they got so far in they were buggered.
- Ayre Oh dear. Well, hindsight's a wonderful thing isn't it?
- Have you done any work on off-shore platforms - design of them or safety issues?
- Lewis No, not really.
- Ayre Alright. Well let's move forward then to projects that are related to the environment.
- 2/22 Lewis I've done a little there. Even a salt field - a solar salt field - like the one at Onslow in common with all the others they do have an impact. We had to write very long reports about their environmental impact and firstly it's on the mangroves. You know, despite the vast areas of mangroves we've got, every last one's been counted these days and then the algal mats behind it and brine shrimp, the little things that live in that top inch or so.
- But, you know, with all the things we've been talking about for me you've got to have an impact but what guides my life - hopefully has

done is **no net loss. No net loss.**¹² It's possible that you've actually improved things.

Ayre I think that's called sustainability these days isn't it?

Lewis Yes, probably is, yes.

2/23 Ayre It relates to it anyway so I suspect that you've been involved - probably indirectly - in conservation of the natural environment.

Lewis Yes particularly on the Ord Dam where - and the diversion dam - where we didn't do an environmental study but if you did one in retrospect you'd come out with lots of plusses - far exceeding the minuses.

Ayre We've touched on gas, and electricity, and energy, let's move on to industrial processes. Have you been involved in the development of industrial processes?

2/24 Lewis To some degree. To some degree.

The synthesising of products from natural gas. We spoke about that a little while back and it's very big in my mind. And for a chap whose been trained in civil engineering and rock mechanics and soil mechanics it seems a big jump to get into gas technology. But I've been interested in gas technology, oh, since about nineteen eighty for close to thirty years. Now we were taught very good chemistry at UWA and I kept going on that in England so my chemistry is as good as it ever was, for what that's worth.

END OF RECORDING 2.¹³

3/00 Ayre Now, just recapping about your chemistry at UWA before we paused there, so you found that the chemistry that you did at university was very useful and relevant?

Lewis Yes, and very well taught. There was a Professor Bayliss and Andy Cole who became a Professor. They were absolutely top lecturers and they did experiments on the bench which always worked and they were a very inspiring pair. So my chemistry is still not bad.

Ayre Well perhaps we can go on from there then to talk about industrial processes. Were you involved in the oil and gas and chemical industry at all?

3/01 Lewis Just a little bit but mainly in serving infrastructure related to it.

¹² Mr Lewis wished to emphasise the concept of no net loss.

¹³ There was along break of some days at this point.

Certainly in the gathering of gas on the sea bed – [I] had something to do with that - and the piping of the gas whether it be from the gathering point to a platform or from a platform to shore – [I] had a fair bit to do with that over quite a few years.

I'm just looking to see if there's any other reference but this might be a point to pick up that with Multiplex we had a joint venture from about two thousand to two thousand and five and during that time we were instrumental in calling tenders and designing and constructing a gas pipe line from Bayu Undan near Timor to Darwin.

3/02 That was five hundred and seven kilometres totally under the sea with no islands in between. The diameter was twenty six inch - 'cos they still speak in inches - wall thickness about one inch - had to be coated with concrete so it wouldn't float. And that was all single pump station at the platform at Bayu Undan with no further boosting all the way to Darwin. It was I think a hundred and ninety five pounds a square inch. That's getting on for the same sort of length as it is from Mundaring to Kalgoorlie.

It was a monumental job and once we got organised with it - the barge laying - is done by barge about three hundred metres long – a special barge. You deliver the pipes to it [and] it's welded into lengths about three hundred metres long. They feed into the middle to a central point where it's fed out the back and laid on the sea bed.

3/03 Lewis So the welds have all got to be perfect at that time because you can't go pulling the thing up to repair welds. And you also finish up - when you're cranked up - laying as much as four kilometres a day.

It's really a very sophisticated operation. It worked well. Nothing went wrong.

Ayre So can I take it that as the pipe was fed into the sea when you came to the end of a section of pipe you then welded more on to it and fed it in?

3/04 Lewis Yes. Let's say the length was three hundred metres I think it was a fraction less than that. So you do all the welds on board in those lengths and test them. Then you had to join those lengths together in the middle of the boat - vessel - which is what they call the firing line - and that last one has to be welded and tested on the spot because you can't pull it up again. It gets laid on the ocean bed in a giant 'S' curve and at twenty six inch and wall thickness what it was, there is flexibility provided the lengths are fairly large. It's a very sophisticated operation.

Ayre Why an 'S' curve?

Lewis Because it lays flat on the bed in a trench that you'd prepared then

coming towards the vessel it curves upwards and then finally curves in the reverse way as it comes off the vessel. It's a giant S curve - and under tension the whole time - under tension by anchors.

Ayre To keep it under control?

Lewis Mmm.

Ayre Yes. You mentioned that it was coated with concrete to make sure that it didn't float. So the concrete was on the outside of the pipe was it?

3/05 Lewis Yes. There was a lining inside but that was a normal sort of lining - a bitumastic lining. The pieces of pipe¹⁴ - they were Japanese pipes [of] top quality brought from Japan to Malaysia. The coating was done in Malaysia.

The pipes were brought down in ten thousand ton barges and never ever saw the Australian mainland 'cos there would have been problems with that. I think there were eight barges involved continuously bringing pipes.

But it was cheaper to do the coating that way than it was to try and do it in Darwin.

Ayre What sort of problems would you have had if they'd been on to the Australian mainland?

3/06 Lewis Mainly union problems. That might be less now than it was then but it was a serious problem then and that concrete would have been double the price, you know, per metre or square metre. But that technology is what makes it possible for people like Inpex with a big project north of Broome to talk about eight hundred and fifty kilometres line to Darwin which they've said they definitely will do. There's no special difficulty with that. And also Woodside are saying if they're going to have all these native title problems and various disputes with people in Broome they'll bring theirs direct to Karratha. That's quite feasible as well.

Ayre So let's go on then to synthesising of products from various feed stocks. I mean, we're talking primarily about natural gas I think aren't we?

Lewis Mmm.

Ayre What work have you done on synthesising products from natural gas?

¹⁴ The term 'lengths of pipe' is more appropriate.

3/07 Lewis There's nothing constructed yet but for several years we've been following various technologies. The dream of a lot of people round the world but particularly a few in Australia is to be able to synthesise methane - which is what natural gas really is - to, well, ethylene for one but more particularly to fuels whether it be diesel or gasoline.

Various technology exists one is a thing called Fischer Tropsch the big oil companies all know that but it's rather expensive. The one we're chasing is an intermediate step of converting to acetylene which in the past has had a few explosion problems, but it's very controllable now. And then from acetylene to ethylene. And for people in the chemical industry Australia's always been short of ethylene - still is - and that's what held our chemical industry back as much as anything.

3/08 Lewis But having got to Ethylene you can go to polyethylene, polypropylene [and] a lot of the rest of the petrochemical industry. So yes we're dealing with Synfuels in America. There's final test of a midscale plant just finished. We're in a joint deal with a Korean company. We've got no other partners in Australia but, yes, it's looking fairly optimistic but it'll take another year or two and if we build anything it will be at Onslow or nearby.

Ayre So you see that as part of a petrochemical complex do you?

3/09 Lewis A limited petrochemical complex. And why Onslow? Because there's plenty of gas round there and some of it coming ashore fairly soon.

We also were involved in a salt field there and we have further ground near the salt field. You normally go with a salt field to caustic soda. It needs a power plant so you can get power there reasonably cheaply. You have, automatically, a by-product [of] chlorine which leads to some difficulties but it's essential in all the plastics industry. Doesn't look like it but that's the basis, is chlorine. In order to handle chlorine for export if you need to - or even round Australia - a good way to do it is to make ethylene dichloride or vinyl chloride monomer - we [would] like to do that at Onslow - and that's really why we need our ethylene.

Several years ago, in fact probably six or seven now, there was a proposal at Karratha - they called world wide tenders [and] Dow and Shell in a joint venture won it.

3/10 And after a couple of years they just gave up [as] they could not solve this ethylene problem.

If you're in the Middle East some of the gases are rich in ethane and a way of making ethylene is by ethane cracking. That's not

available to us because all of our gases are very low in ethane so we have to find another way like the ones I was describing.

One day the north of Australia will be quite big in the chemical industry.

Ayre Yes. Certainly there's the prospect of it isn't there?

Lewis Mmm.

Ayre Well, while we're on the topic of industrial processes perhaps we can go on to resources such as minerals and gold and silver etc. Have you done any work in that area - extraction of minerals?

3/11 Lewis Gold and silver I haven't. And on the extraction not really. It's to do with the materials handling side of it.

In that regard I was involved as the consulting company at that time in the sixties at Kambalda. [I've] been involved in a few other things since then like iron ore. Ilmenite is one too.

In the last few years we were involved with a Multiplex joint venture in setting up an ilmenite extraction process in Mozambique in Africa. We used some materials which had become excess to requirements in Bunbury by a project that BHP had abandoned and we shipped all that stuff from Bunbury over to Mozambique. Landed on the beach 'cos there's not many people there - reassembled it all and did all the infrastructure that was necessary including power [and] the wharf.

3/12 Lewis That's up and running very happily. That was good exercise in logistics. And that's really what Australians are good at is logistics, whether it be iron ore, nickel or whatever. We're not so good at processing. Hopefully that will improve.

Other than that, well, ilmenite. Salt. I've mentioned solar salt. In that case at Onslow Salt it was pumping sea water in [and] letting the sun evaporate it, crystallising it, washing it, stockpiling and conveying it out over a wharf so ships could be loaded at Onslow. That's all been done several years back and it's working quite happily.

Ayre What quantities of salt were you producing?

3/13 Lewis In stage one two point five million tons a year so it was a quite sizeable operation. It was all fully automated as far as ship loading went. From the point where you were reclaiming from the stockpiles, conveyors were continuous to the ship loader and the guy in charge of the ship loader controlled the whole thing. And you could theoretically load ships with just that one guy but we used to have

four or five.

Ayre I suppose handling salt is a highly corrosive business isn't it?

Lewis Yes.

Ayre How do you deal with that with that with your plant and equipment?

Lewis You have to be very careful with steel structures [to ensure] that the coating is good and that you maintain them. You can use wood to a degree which lasts longer than steel oddly enough but all the mechanical equipment reclaimers and things like that you've got to be very careful. Trucks - hose them down at the end of every shift. Aluminium is pretty good. Aluminium [is] probably better than steel for most structures.

3/14 Ayre Why is that?

Lewis It's just more resistant to salt water corrosion.

Ayre Now, we talked informally about the extraction of limestone at one stage. Why was that done? What did you do with it?

Lewis In the case of limestone, which we're still doing, we've got very large deposits of metallurgical grade limestone on North West Cape. I say we it's virtually our family in association with Cockburn Cement. We've had it for the better part of ten years. We sell some stone, not continuously, but every couple of years we sell a bit of stone.

3/15 Lewis This is Miocene age - ten million years old - it's very dense [with a] specific gravity of about two point six eight which is, you know, is slightly better than the average granite. It's got no voids in it but principally in the end it's going to be used really as a purging material in refining steel especially by electric furnaces. We've got environmental approval we've got our designs pretty right [and] got Shire approval in recent times so, yes, we hope to be building something there - certainly in this calendar year.

Australia imports metallurgical stone from Japan [at] about a million tons a year. We expect that we can stop that happening.

3/16 Ayre So when you say metallurgical stone limestone is added to the stock in the furnace is it, the iron ore?

Lewis It is.

Ayre And then smelted together. How does that work?

Lewis And then that purges out as a slag so it brings out any alumina or

silica that's in the ore which inevitably there's a fair bit. Particularly in our iron ore [which] is getting down on grade it's not all sixty four percent. It's sixty percent [which] means the other four percent is odds and ends that they need to get rid of. That's what metallurgical stone is for and if you put poor quality stone in [as] limestone of course the impurities in it have got to be purged as well.

The big market for us in India. India's converting steadily to electric furnaces and they don't have any good limestone themselves.

3/17 Ayre Have you done any work on special and composite material such as plastics and glass, carbon fibre?

Lewis Not really, no. No. The actual process itself that's not been my bag really. Mine has been mostly the civil engineering and to some extent mechanical engineering that goes with it, you know. Generally materials handling.

Ayre Right. Well let's move on then to the subject of hydraulics - water supply, drainage, sewerage, that sort of area which I think has been very much part of your career.

Would you tell me something about the work that you've done in that area?

3/18 Lewis Particularly as a young engineer. I had been a cadet, as I think we discussed before, with the Public Works Department, and when I came out of my cadetship and finished my degree I took over as an engineer in design. And there weren't too many design engineers around in the Public Works in those days - they were nearly all on construction.

Anyway, I finished up from nineteen forty eight through to about fifty two designing dams and things like that. I went on post graduate leave overseas from fifty two - fifty three. Came back in fifty four and went on with dams and weirs. Of the various one's that I did, the best of them probably was the Ord Diversion Dam. I designed and selected a site for the main dam but I'd left the Department by the time it was built but it's basically my design.¹⁵

3/19 Lewis I was also involved in the raising of Mundaring Weir. That was my first job out of uni really - the first big one - and the raising of Wellington Dam that followed immediately afterwards. And a series of earth filled dams - Waroona, Harvey Dam, Logue's Brook - several others down that way.

But soon after I'd left the department, say in the seventies, suddenly

¹⁵ Mr Lewis noted later that before this was decided it had been proposed to build a converse dam at a different site.

people didn't want to build dams any more. The environmental guys didn't want to divert river flow and things like that. So it was a good time for me to leave and direct my skills elsewhere.

3/20 Lewis Hopefully there's a bit of a change now because I'm a believer in conserving water particularly in the north and, you know, we'd hope that both Federal and State - plus people themselves - are now a bit more interested in using their water availability in the north.

Ayre You mentioned dams and weirs. Can you tell me, what is the difference between a dam and a weir?

Lewis Yes. Commonly a weir is a lowish structure. The Ord River Diversion Dam really is a weir but being fifteen metres or so high, you know, it's of considerable height so it didn't get called a weir but it technically is. So any low structure particularly if it's got a lot of gates or a long overflow is a weir. And in places like Egypt and India would be called a weir.

3/21 Lewis Another name which amounts to the same thing is barrage. Again, British engineers - India and Egypt - barrage was common and is used in Australia quite a bit too.

A dam really is a big plug whether it be concrete, earth, rock-fill, but with limited spill-way and certainly not too much spill-way over the top of it and usually fairly high structure.

Ayre So you refer to Mundaring Weir?

Lewis Mmhmm.

Ayre I take it from that, then, that Mundaring Weir right along the top of it is an overflow facility?

Lewis And certainly before it was raised something like two thirds or three quarters of its total width was a weir. With the raising the width of the weir was left the same so the weir is probably only a half of the total length now.

3/22 Lewis That name was originated for it in the time of CY O'Connor. I think it'd be fair to say too at that time the word weir was more commonly used than it is now.

Ayre Going on from dams and weirs, then, have you done any work on water catchment areas?

Lewis A fair bit on water catchments. Again in the same time with the Public Works Department many small water catchments were used with smallish dams for water supply for various country towns.

In my time the number of country towns with independent water supply rose from six to thirty six. I think there were only six local water supplies when I started. That would have been Geraldton, Northam, Kalgoorlie, Collie, Bunbury, Albany, Busselton.¹⁶

- 3/23 Lewis That's probably more than six but that was about it. Then all the smaller towns they were gradually served with water from local catchments generally in the nineteen fifties and sixties. A lot of those have since been caught up in the reticulated water from the Goldfields scheme.

Bore fields - not many supplies of water in the west are from bore fields. Bunbury certainly gets water from bores. Geraldton, Busselton, and of course, the Metropolitan area at the Gnangara Mound which we're sitting over the edge of.¹⁷ As much as sixty percent of our water's coming from bores. They've been a great saviour for Perth.

- 3/24 But it can't go on forever. If we're going to mine the water the quality will deteriorate and the water table's dropping so people don't like that.

Yes, so there's a limit to bore fields in the west.

- Ayre When you talk about water catchments in small country towns what form did a catchment take? I mean, I think of a large rock face for example, but that wouldn't necessarily be the case would it?

- Lewis No. Most of the water catchments in the south west wherever we could get it we'd take virgin forest and the Public Works philosophy was the same, really, as the forestry people to try and preserve those catchments.

- 3/25 Lewis [There were] several reasons for that but one is to prevent them going salt¹⁸ 'cos most catchments in the south west once they're cleared they go salt to a greater or lesser degree. So, yes, we would pick virgin forest and we'd protect it and make sure that it wouldn't get cleared.

So two of the big ones that we dealt with at that time one was the Collie River catchment which was already showing signs of going salt in the nineteen fifties. There's no question it was going more salt. It was serving irrigation mainly, which it still does, and becoming marginal. The Collie catchment was very large. It

¹⁶ Mr Lewis latter corrected this list to be Geraldton, Collie, Bunbury, Albany, Busselton and Harvey and possibly included Moora but excluding Northam and Kalgoorlie which were supplied from the Goldfields Water Supply Scheme.

¹⁷ Referring here to the fact that the location of the house where the interview was being conducted was over the water mound.

¹⁸ The term 'go salt' means that the water becomes saline.

involved several towns including Collie itself. A large part of it was held privately so people could clear the land and they had done so. There was a mining activity on there - several mines in fact.

We acted to prevent further clearing which was extremely unpopular at the time.

3/26 Lewis But now, I suppose you'd have to ask people involved with it now. But I think Collie is not getting any worse. I think they've arrested the decline there so everyone would now agree that was a good thing.

Denmark River was another one. Denmark River was higher rainfall [and] the catchment was not so heavily cleared. And we acted on that one and I think have saved the Denmark River. Others down there nearby the Hay and the Kalgan they were really gone beyond retrieval. And a lot of our other big rivers the Murray, Frankland and Blackwood. I can't see that we can do much to retrieve the position. They're gone as far as we're concerned; as far as the State is concerned.

Ayre So this salinity is a consequence of clearing the land is it?

Lewis Yes.

3/27 Ayre Right. Now if you didn't have a forest area to use as a catchment what else did you use?

Lewis For small towns you could use a bitumen catchment. Sometimes you could, sort of, corrugate open fields in the form of roads - that was called 'roaded' catchment. They depend on the rain and you have to have a decent rain to make them run but there are still a lot of that sort of catchment in small towns round the wheat belt.

Ayre Well, going on then. We've touched on bore fields. Have you done any work on desalination plants?

Lewis Yes I did a little bit on that in the early years but more particularly in that joint venture we mentioned with Multiplex. My son, in particular, Don Lewis, he was in charge of their engineering division.

3/28 Lewis He'd been largely responsible for that gas pipe line I mentioned up at Darwin. But this one - the desalting plant at Kwinana - he organised that and I had a fair bit of input in to it to try and get the costs right.

The technology was fine. It'd been used in the Middle East for quite some time. I don't know why people were so frightened of desalting as a process. They were saying 'It's new. It's innovative'. That wasn't true. The technology well existed [and proven].

So we went from a standing start to a plant that could serve about twenty five percent of Perth's water supply. Never given any trouble and we knew it wouldn't. And it wasn't just one. There were three or four companies we had to choose from. We went with one called D'Egremont - [a] French company - and the French are particularly good at these processes.

3/29 Lewis And I think Western Australia got a lot of Brownie points for that having put the plant in and the other States with similar problems - even Sydney - were left standing and wondered what had happened.

I don't agree too much with putting the second plant down near Harvey. I would have put the second plant right next door to the existing one. But the principle's there. I suppose for Western Australia as a large State it pretty much assures our future because a desalting plant can produce water for about say a dollar ten to a dollar twenty a cubic metre. That's not a bad price. You know, people say they can do bore water for eighty cents but even bore water's getting more expensive - even if it were available.

So I think Perth can be assured it's not going to be strangled by a shortage of water.

END OF RECORDING 3

4/00 Ayre Going on then. You mentioned water distribution systems. What work did you do on those?

Lewis There's two main transmission systems in Western Australia I had a little bit to do with them - not a great deal - but one is the one that originally served Kalgoorlie on its own from Mundaring. It was gradually extended over the years, north and south, to serve farmlands and other towns in the wheat belt.

The second of that came from Wellington Dam and went to Narrogin and served the Great Southern and was gradually extended. I just had a little bit to do with those but there was no magic about that. It was just like the fingers extending out into the wheat belt.

4/01 Lewis It was a Godsend for the farmers because they were relying on excavated dams. In a bad year they were carting water. So, yes, that's about all I did on that. And water supply distributions that's more or less the same thing. [I worked on] some distribution systems related to towns but generally not very extensive.

Ayre You mentioned the Great Southern that, I think, in part at least is an irrigation system isn't it - for rural areas?

- Lewis I don't think there'd be much irrigation from it because it's a very limited supply. No, I think for producing vegetables, and what not, you wouldn't be allowed to use it for that but back yards can. But not for growing apples or peaches or anything like that.
- 4/02 Ayre Going on then to irrigation schemes. You mentioned the Ord River. Did you have any involvement in the design of the irrigation scheme there?
- Lewis Yes that was really all done in my time. I mean it was designed and constructed under my control.
- So, when the diversion dam was put in there was no main dam, so, we had to work on the storage in the diversion dam when the river wasn't running. It meant that the top three or four metres we had to pump off. We put in a pumping station - a big large channel which was the final size of channel. The irrigation area was about thirty thousand acres in those terms or twelve thousand hectares. We designed the farms, the supply of the water, the drainage system went to the farms and the roads, and what not, and electricity supply had to be right through it.
- 4/03 Lewis A point worth mentioning about the Ord - and it applies to any irrigation system - is that you have a supply which is a large channel going into fingers of smaller channels but inevitably with flood irrigation there's excess water - and particularly if it rains you've got to get rid of the excess water. So you have a complementary drainage system which starts in small channels and gradually gets larger as it goes downstream towards the river and discharges back in to the Ord River in that case.
- So we designed all of that and if you don't do it - there's examples in Pakistan, say, and parts of India which I visited at the same time this was being done - where a drainage system hadn't been put in so there was wholesale flooding for long periods and, you know, given twenty, thirty, forty, years a lot of that land was finally going salt.
- 4/04 Lewis That's a serious problem they're losing so much land where they can ill afford to lose it. The Ord is - starts with - very fresh water. The drainage system is good [and] it certainly should not go salt and it shows no sign of doing so up to now.
- Ayre So you're suggesting, I think, that if you don't manage the salt content of the irrigation water then downstream in your irrigation schemes the salt settles into the ground that it's irrigating?
- Lewis Mmmm. It will build up. Yes.
- Ayre It will build up. So is that caused by evaporation of the water?

- Lewis I think it, say, principally it is, yes. Yes.
- Ayre So the irrigation scheme if it's not properly managed becomes a salt collection pond doesn't it?
- Lewis Yes. Yes. Yes.
- Ayre Which of course destroys the whole object of the exercise doesn't it?
- 4/05 Lewis Yes. Yes. Yes. And is almost irreversible. Once land has gone salt or – in American they call it black alkali and white alkali: slightly different salts - but it's almost impossible in a finite time to bring those soils back
- Ayre With regards to flood control then you've done some work on that have you? What have you done?
- Lewis Yes. Well there was a flood control problem on the Ord to prevent it flooding over the irrigation lands we'd just created so there's a levy goes from the Ord diversion dam for about four kilometres all the way to the town of Kununurra. It would be between two and three metres high and has been very effective for flood control.
- 4/06 Lewis Finally once the main dam was built that really was the main flood control in itself but the levy is still there just in case. We did some work on the Fitzroy River in West Kimberley that was a monumental flood control problem because there was no dam at all on the Fitzroy and there still isn't. Flood control systems we put in there were partially successful but in an extreme flood you just couldn't cope with it unless you had a dam.
- Sedimentation you've asked me about before. Sedimentation on both the Ord and the Fitzroy - a major problem - the way to really tackle it is to get back in to the catchment destock it and rescue the catchment by rehabilitation. In the case of the Ord that's been extremely successful.
- Ayre When you talk about destocking you're talking about taking grazing animals off it are you?
- Lewis Yes.
- Ayre What? Cattle, horses?
- 4/07 Lewis Cattle, horses, yes, and donkeys. Donkeys have been largely shot out now so they're not the problem they used to be and in the case of the Ord they - several of the stations which are owned by absentee owners they - just leased, so the government forced them to take the stock off.

- Ayre Have you done any work on coastal erosion?
- Lewis Yes I did but again that was Public Works. Quite a bit on that. Mandurah was one. A little bit on Geraldton and along this coast here even.¹⁹ But we generally get these sea breezes which means there's a littoral drift from south to north. Seasonally the other way but [in winter] the net drift is south to north.
- 4/08 Lewis There was a hydraulic model station set up by the Public Works and the University of WA Centre for Water Research. They're involved in it as well. Our problem - though while people complain 'cos they can see it - is not a major problem like the Californian coast.
- Ayre You mentioned hydraulic models did you have any involvement in the design and development of the modelling facilities?
- Lewis Yes I think in my time that the hydraulic research station was set up by the Public Works Department. It was out in Floreat Park as far as I know the building is still there but they later combined with the Metropolitan Water Supply - whatever they were calling it then - I think it was the Water Supply Sewerage and Drainage Board²⁰ then and the University. So they got their heads together with a limited number of experts it was a good idea to get their heads together on it.
- 4/09 Ayre We've mentioned salinity and touched, I think, on water quality in some of the catchment areas for the small country towns. What was the water quality like for consumption?
- Lewis Sometimes it was pretty poor. In some cases it was a matter of having a water supply that you could drink and wasn't going to do you any physical harm rather than have none at all. So some of those wheat belt towns, yes, they were pretty marginal - mostly due to salt.
- Some of the ones in the more built up areas where the rainfall was more assured there the quality was still not that good because it came off catchments that weren't well protected and in the early years there was no treatment of the water no chlorination so people they just put up with that and of course you get resistant to it. These days I think every public water supply is treated.
- 4/10 Ayre So you're suggesting that people that live in a locality they adjust to the water supply with regards to its salt or its biological content are you?
- Lewis Well they do. India and Egypt, you know, have sweet water canals.

¹⁹ This is a reference to the coast line, north of Perth at Quinns Rock, where the interview was being conducted.

²⁰ Mr Lewis later amended this to read 'Metropolitan Water Supply, Sewerage and Drainage Department.'

Well they're absolutely dreadful by our standards but it doesn't harm the locals. They're brought up with it.

Ayre You mentioned sweet water so it's a relative term is it?

Lewis Yes it is. There's such things as sweet water canals in Egypt and that's usually not sweet water as far as we're concerned.

4/11 Ayre Now with desalination of course there's the disposal of waste water. Have you touched in your career in the treatment and disposal of waste water?

Lewis Not really. Sewage treatment was never a big deal for me but I did have something to do with the ocean outfalls. There's one being built up here north of Quinns at the moment and I think they're going to launch the outfall in March when the weather's quiet.

But there's three others at least. One at Swanbourne, one at Rockingham and I think one further south than that. In it's launching technique you have to prepare a bed for the pipe and then drag it out with a couple of large tugs when the weather's good. That's all I've had to do with the treatment.

Ayre So the pipe is fabricated on land and just pulled out - partially floated out, I suppose?

Lewis Yes. Yes.

4/12 Ayre And then sunk on to the seabed and anchored down?

Lewis Yes. It's a bit like the pipeline for the gas that I described. You need a coating on it to make sure that it's just about in balance and that it will sink when it's supposed to sink.

Ayre Yes you wouldn't want it floating around would you?

Lewis Mmm.

Ayre Now let's move on then to a completely different area, that of civil and structural engineering. Have you had any involvement in the construction of highways and road pavements?

Lewis Not a lot. A little bit but mostly when it came to that we would get the Main Roads to do it or the local councils. Foundation materials for building, yes that was a different thing. So foundations I did have a fair bit to do with.

4/13 Ayre So the preparation of material for the foundations of roads you're talking about are you? Or are you talking about buildings as structures?

- Lewis No, the road pavements. Roads as such, yes, I had very little to do with it. But a couple of airfields including the one at Karratha [I] had a fair bit to do with that because that had to be prepared for a depth of about a metre for heavy aircraft and we had to work with the [limited] soils that we could find. That's really the only pavement I've done is the one in Karratha. And that's probably been upgraded since I did it.
- Ayre Coming on then to transport systems, and the design of railways, and feasibility of railway routes. Have you done any work in that area?
- 4/14 Lewis Yes quite a bit on that. The best one I suppose was the location of the Robe River line from Pannawonica through to Cape Lambert. That was difficult rough country through there and also involved the crossing of the Fortescue River. I think the total length was a hundred and four miles. That was done in about nineteen - yes in the mid sixties. So we as consultants - not as Public Works - as consultants, did the location of that and the design of the culverts 'cos that's the important thing. You want to stick to the high ground if you can when you're going towards the coast and not go in the valleys because you get all sorts of problems with culverts from side drainage but also a lot more earth works. Anyway, that one worked out pretty well.
- 4/15 Lewis Bechtel of America did the actual construction. Well they did the construction of the whole route. The contractor was MKMO which was Morrison, Knudsen and Mannix Oman. They did most of the early railway lines in the north. And they were heavy railway lines for the iron ore [with] which there was nothing comparable anywhere in Australia at that time. I think the axle loads were thirty ton axle loads.
- Ayre So how do you go about identifying the optimum route for a railway line?
- Lewis Well, first I suppose you need to know what sort of locomotives you're intending to use. Whether it's going to have fully loaded conditions in both directions which generally they don't. The fully loaded trains going to the port and the light trains coming back which is, you know, about one quarter or one fifth of the weight.
- 4/16 Lewis So generally you can set criteria based on that. And it used to be - and I shouldn't think it's changed much now - that going down towards the port with the loaded train you couldn't have more than a two percent grade in your favour because it could get slippery in a storm. But the more important thing was against the load - 'cos it can't be just down hill all the way - you're going to have little hills here and there usually about half a percent against the load.

Coming back with the unloaded train you can drop off some locos if you want to but, yes, you can face up to two percent against the load for a light train coming back. They were generally the criteria used.

4/17 Lewis People doing the Avon Valley railway - which was nothing to do with me but it was an early railway - I think the grade up there is the same sort of thing. Probably a few pinches near two percent but in that case if you can keep near one percent that's what they'd rather do. We've been doing bits and pieces in West Africa - or my son has recently in the last year or two - and they're the same criteria we're using. That's in Cameroon, a four hundred a fifty kilometre long line.

Ayre I presume the trains themselves are quite long and I presume that creates problems of its own doesn't it?

4/18 Lewis Yes. I'm certainly not an expert in the actual trains themselves but, yes, these trains we've got in the north here are as long as any in the world. Let's say it's a mile long which is somewhere near the mark.

You occasionally see things in the paper about trains that are considerably longer than that but it pays you not to have all the locos at one end [and to] have locos in the middle 'cos it serves as a bit of an anchoring point, 'cos a train that long if it's going with changing grades - which is quite inevitable - they can telescope a bit [with] what they technically call snatch. And it's very nasty and can cause a derailment 'cos if that snatch hits the middle of the train it can force some of the ore wagons up and off the line.

Yes, snatch is bad news so and, you know, speed limits sixty Ks²¹ an hour. You'd like to go a bit faster but on average its best to reckon you're going to do about sixty. You know, they're a hundred tons per wagon - hundred and thirty tons all up - in thirty four foot lengths, ten metre lengths. It's very intense loading.

4/19 Ayre And a lot of weight in the train?

Lewis Mmm. They gave up having a guard's van years and years ago because the guard was the most vulnerable of the lot and there wasn't much point in him trying to apply the brakes anymore.

Ayre Yes indeed. Now, we mentioned dams and weirs, have you done any work on bridges and culverts?

Lewis Quite a lot on culverts because on those railways and things like that and in connection with irrigation schemes there's plenty of need for culverts. Sometimes in concrete sometimes in Armco corrugated pipe. Bridges much less. Usually if we had a significant bridge

²¹ Kilometres

we'd get someone like Main Roads to do it for us and Main Roads did the bridge over the diversion dam.

4/20 Lewis Also a technical thing. There had to be a section in each span that could be pulled out by an overhead crane so that we could get at the stop logs which were protecting the gates in the case of emergency. Gilbert Marsh did that one. That was a pretty good job.

Ayre What's a stop log?

Lewis Oh, a stop log?. You've got these radial gates in the case of the Ord - or any dam of that sort - and in terms of feet they were fifty feet wide. They were about twenty feet high, sorry, fifty feet wide about thirty feet high, radial gates. So they're on an anchor or a trunnion and they [rotate] - work - easily without much friction

Ayre So they rotate do they?

Lewis They rotate upwards and out of the water.

Ayre Yes?

4/21 Lewis Completely. But occasionally on the Ord catchment in the early days you'd have whole trees would come down in the flood. Whole trees that had washed off the river bank somewhere and they could jam a gate and you had to have a means of coping with that.

It wasn't so bad if the gate was shut but if it was half open you had to get rid of it. And that was one way of doing it - was to get the stop logs down so you could then get men in behind and free the gate. And [a] stop log is the thing - full span it's got to be - but they're about one metre height. So you're going to put, say, seven or eight of those down to make the full height.

Ayre Right so they're like a shutter that you build into place?

Lewis Horizontal like sleepers you're just dropping down in there.

Ayre Like railway sleepers I suppose?

Lewis Yes.

Ayre But giant ones?

Lewis Yes.

Ayre And you need a crane to do that obviously.

Lewis Yes. A mobile crane would probably do it but a big dam like the diversion you've got a special crane on rails to do it.

- 4/22 Ayre Right. Going on from dams then, have you done any work on ports and harbours and jetties?
- Lewis Quite a bit. Mainly in relation to materials handling of iron ore, of salt, and more recently on this limestone thing of ours at North West Cape. But the harbour structures are roughly the same for all of those things and the ones I've had experience with are not container ports they're export ports with virtually nothing coming in. So containers are a different thing.
- The cheapest way to do those ports is in the form of a jetty rather than a land backed berth. So you just do a jetty in steel where, say, previously it'd be done in timber like all the old jetties for loading wool and timber. So now they're done in steel. You can make them cyclone proof as shown in many cases up north.
- 4/23 Lewis That's the sort of structure that I've had experience in. It carries, usually, a conveyor, a pipeline, limited trucks [because] we don't usually take fully laden trucks out there. And then a mobile or fixed ship loader on the end which has got pretty big stresses in terms of cyclone. Then you've got to have fenders so that [when] the ship comes in if it get out on control a bit it doesn't actually damage the structure.
- Dredging and those things, yes, I've had a fair bit to do with that.
- Ayre So, these export ports as you refer to them I presume from what you've said that they are places that handle minerals or rock or ore in bulk?
- Lewis Yes. Yes. There would be iron ore, bauxite, limestone, salt, you know, concentrates of various kinds.
- 4/24 Ayre You mentioned dredging. Have you done any work there?
- Lewis Mmm.
- Ayre Tell me about that.
- Lewis Well nearly every one of these ports I mention up north - some that I didn't have a lot to do with was - Port Hedland I didn't have a lot to do with - but you eventually, if not initially, will have to dredge because none of those [have a] natural depth that's nearly good enough. These big carriers now [are] two hundred thousand tons, they're needing a depth of sixteen metres and twenty if you can get it.
- We've got an advantage - we can work the tide up there which is handy but [in] many ports you can't work the tide, so you find

you're dredging depths of ten metres or so sometimes in a number of steps as the ships increase [in size].

4/25 Lewis But it's very interesting to take core samples and try and get an initial assessment of how difficult it's going to be and get the pricing right because [there's] only four or five companies in the world that really handle big dredging contracts and sometimes they get together and fix the price.

Ayre Perish the thought.

Lewis And another time they'll deny that your statements of the materials to be dredged are right. So sometimes you'd pay them to go in and do their own drilling alongside yours.

Ayre So you'd get them involved in quantifying the work that they're going to have to do sometimes?

Lewis Yes. Yes.

Ayre You mentioned Port Hedland working the tide. What did you mean by that?

4/26 Lewis Port Hedland, Cape Lambert, Dampier - those major ports they've got a tide varying from four metres to six metres and some a bit higher at springs and mean sea levels about halfway in between. Unladen ships coming in can come in a low tide but they try to work it so that high tide - particularly if it's a big ship - that the loading rate per hour is such that it has got a window of a couple of hours of high tide when it can leave. That's really working the tide.

And another classification is to say at mid tide, or better, means on an incoming tide - once it's got to mean sea level - you've then got a six hour window. But some of them don't have that long and they've got to get going quickly 'cos the last thing you want is one to go aground on the falling tide in the middle of the channel. There's damage to the ship there's damage to the channel.

Ayre Yes, and of course it blocks for everybody else doesn't it?

Lewis Mmm.

4/27 Ayre We touched on building projects briefly. Can you tell me what large building projects you've been involved in?

Lewis Well foundations was a special thing of mine so, yes, I used to get involved a little bit in foundations for city building even here in Perth. That became more specialised as time went by and I guess consulting engineers only do a limited amount these days just general structural consultants.

Power stations, yes, we did a bit as consultants on power stations because many of them here in the west were done by architects oddly enough. The architects used to employ us as engineers to do both the structural stuff and the foundations. Some of them need pile foundations but generally not.

4/28 Lewis Nuclear reactor is in this list here. I've done nothing on nuclear.

Shopping centres I've certainly done a fair bit on but the main [issue] for shopping centres is large [roof] spans but not very high rise. Foundation conditions usually not a problem. Yes, so I've had my fair share of those.

Ayre So shopping centres are, I think, from what you've said anyway large floor area, large span roofs, but not particularly heavy buildings?

Lewis Yes. Yes.

Ayre Is that correct?

4/29 Lewis The main thing with a shopping centre is to try and prevent a fire. It does happen every so often - in the roof as a rule - and you try and work it so that if there is such a fire it's contained very quickly. But you see many pictures in the papers [showing that] the first thing that happens is that the roof collapses which is a major problem and you want to try and avoid that. Not at all costs but you certainly want to try and avoid it.

Ayre So how do you contain the fire?

Lewis Usually with bulk heads in the roof. That costs but it's worth doing.

Ayre It's worth doing if the day ever comes?

Lewis Yes.

Ayre Now moving on then to resources in a slightly different vein. Have you done any work in the timber industry?

Lewis Very little. The main bit I did was - as a consultant - was in the woodchip mill at Manjimup. That was industrial process but very limited just producing chips and sending them off to Japan for making paper. All the equipment you buy for debarking and chipping is all bought in.

END OF RECORDING 4.

- 5/00 Lewis It's all proprietary stuff. Some from Europe. Some from America. So that was the one thing I had a bit to do with there.
- Ayre So you were involved in the process of manufacturing the chips were you?
- Lewis Yes, and carting them.
- Ayre And carting them?
- Lewis And loading them at Bunbury. At the little wharf at Bunbury.
- Ayre Did you do any design of stock piles or...?
- Lewis Yes. Stockpiles, yes. The materials handling we did.
- Originally they were shipped by train but that's not happening any more. I think it's by road now. Still they're exported from Bunbury. Quite a good little facility there at Bunbury – stockpiling, reclaim and loading ships.
- Ayre I always think of a pile of woodchips as being highly flammable. Is that true?
- Lewis No.
- Ayre No?
- 5/01 Lewis Not really. It'll burn on the outside but it can't get air to the inside in sufficient quantities. It'll smoulder but, no, you won't see great walls of flame or anything.
- Ayre We have touched on bulk transport of minerals and ores and we've talked about trains and iron ore and the shipment of ore in bulk. Have you done any work in the mining industry apart from those aspects of it?
- Lewis Not really. On nickel we did a fair bit in the early days for Western Mining. That was beneficiation. Because nickel coming out of the ground in those days was about two percent nickel so you had to get a concentrate to somewhere around thirteen or fifteen percent. And we did a fair bit of that.
- 5/02 Lewis But we really did what Western Mining told us to do 'cos they were the experts on that. We did the structural materials handling around that to their satisfaction. We've never done anything to do with the smelter at Kalgoorlie. Never did much to do with the concentrator down at Kwinana. So that was the limit of what we did on nickel.

And iron ore, again it's beneficiation, but mostly our iron ore is

going out - let's say it's sixty percent average of Fe - there's a great deal of the ore round Newman and Tom Price which is about forty percent and they are slowly using more and more of that and upgrading it which is not too hard to do. Many consultants including my old firm get involved in that. It's not real hard actually and the volume is great.

5/03 Ayre Well John I think I've covered all the areas I wanted to cover with you. Is there anything you would like to add?

Lewis I'm just looking at my notes here. I doubt that there is.

You asked me once before about lessons learnt from mistakes and failures by oneself and other people.

Ayre Oh yes. Yes.

Lewis Well I suppose there's lots of lessons you learn but you don't think of them often. If you come across a similar problem you think well I won't do that again but I can't remember too many off hand. But there would have been plenty of them.

Ayre I think that's true of all of us isn't it?

5/04 Lewis Yes. Yes. But I always believed in taking the blame for anything that was even remotely mine because that put that fire out straightaway.

Ayre Yes, I can relate to that.

Alright, are there any questions you'd like to ask me?

Lewis You're going to give me a look at the draft of these notes are you when you come out?

Ayre Indeed I will, yes. I shall ask you to check them and to correct dates and names and spellings and this sort of thing. Yes.

Lewis Right.

Ayre And if you think of anything you'd like to add then we can put in footnotes to elaborate.

Lewis Mmm. Mmm.

No. I think that's about it.

Ayre Well thank you for talking to me John. It's been very interesting to talk to you and I hope you've enjoyed it.

Lewis I have indeed. Thanks very much Doug.

Ayre Thank you.

END OF RECORDING 5